

Update on California Motor Vehicle Fuel Programs

July 8, 2005

California Environmental Protection Agency




Air Resources Board

California's Air Quality Problem

- ➡ 24 million gasoline-powered vehicles
- ➡ 1,250,000 diesel-fueled vehicles and engines*
- ➡ 34.5 million people
- ➡ Over 90% of Californians breathe unhealthy air



*October 2000 - Diesel Risk Reduction Plan



California Motor Vehicle Fuel Programs

California's Vehicle Fuel Programs

Year Adopted	Gasoline	Diesel	Alternative Fuels
1971	Reid Vapor Pressure	-----	-----
	Bromine Number	-----	-----
1975	Sulfur	-----	-----
	Manganese/Phosphorus	-----	-----
1976	Lead	-----	-----
1981	-----	Sulfur (SCAB)	-----
1982	Lead	-----	-----
1988	-----	Sulfur/Arom. HC	-----
1990	Phase 1 RFG	-----	-----
	-----	-----	Clean Fuels/LEV
1991	Phase 2 RFG	-----	-----
	Wintertime Oxygenates	-----	-----
1992	-----	-----	Commercial and Certification Specs
1994	Phase 2 RFG Predictive Model	-----	-----
	-----	-----	LPG (amended)
1998	Combustion Chamber Deposits (amended)	-----	-----
	Wintertime Oxygenates (amended)	-----	-----
	-----	-----	LPG (amended)
1999	Wintertime Oxygenates (amended)	-----	-----
	-----	-----	Clean Fuels (amended)
2000	Phase 3 RFG (eliminates MTBE)		
2003	-----	Sulfur 15 ppm	-----

Summary of Fuels Program Benefits

Program	Emissions Reductions (tpd)					
	HC	NOx	PM	SOx	CO	Toxics
Diesel (1993)	--	70	20	80	--	25%
CaRFG1 (1992)	210	--	--	--	--	--
CaRFG2 (1996)	190	110	--	30	1300	40%
CaRFG3 (2003)	0.5	19	--	4	--	7%
Diesel (2003)	--	--	0.6	6.4	--	--
Total (tpd)	400	199	21	120	1300	na

CaRFG3 Program

- ➡ Adopted in 1999 - Implemented 2000
- ➡ Removed MTBE.
- ➡ CaRFG3 Predictive Model.
- ➡ Provide additional flexibility to use of ethanol.
- ➡ Required follow-up items
 - Commingling
 - Waiver
 - Permeation
 - Others



Ethanol

- ☞ California regulations allow oxygen levels to be anywhere between 0 and 3.5%, or ethanol between 0 and 10%
- ☞ Federal RFG oxygen content requirement has led to over 95% of CaRFG containing 5.7% ethanol
- ☞ Since 1999, ethanol consumption has increased from historical levels of about 10 million gal/yr to over 900 million gal/yr in 2004.
- ☞ Today, California consumes about 11% of the nation's gasoline and over 25% of the nation's ethanol production

Permeation

- ➡ Permeation is the migration of liquid fuel components through the soft portions of motor vehicle fuel systems
- ➡ Ethanol is known to increase permeation and increase evaporative emissions
- ➡ Joint CRC/ARB study found that ethanol in gasoline increased permeation by about 65%
- ➡ Second stage of test program in looking at LEVs, PZEVs, and flexible fueled vehicles with E85
- ➡ ARB staff is updating EMFAC to provide population specific permeation estimates

Predictive Model

- ➡ ARB staff committed to updating the Predictive Model about every 5 years, last updated in 1999
- ➡ ARB staff is holding public workshops to discuss with stakeholders potential changes to the CaRFG regulations
- ➡ Staff is waiting for the CRC E-65 test program to release its data and final report
 - 12 fuels tested in 12 late model vehicles

Predictive Model

(continued)

- ☞ Predictive Model update is expected to go to the Board in late 2005 or early 2006**
 - Must be approved by the Board**
 - Subject to independent scientific peer review**
 - Follow Administrative Procedures Act to ensure public participation**
 - Must respond to all stakeholder comments**

Alternative Fuels Specifications

☞ Adopted in 1992 as part of the LEV program

- Fuel methanol (M-100, M-85)
- Fuel ethanol (E-100, E-85)
- Compressed natural gas (CNG)
- Liquefied petroleum gas (LPG)
- Hydrogen



Alternative Fuel Programs

- ➡ **Ensure availability of clean alternative fuels for low-emission vehicles**
- ➡ **Recognize and encourage certification of low-emission alternative-fuel vehicles**
- ➡ **Most alternative fueled vehicles are in fleets and are not dedicated alternative fueled vehicles.**

Compressed Natural Gas

Compressed Natural Gas Motor Vehicle Fuel Regulation

- ➡ Title 13, CCR, section 2292.5 adopted in 1992
- ➡ Compositional specifications
- ➡ Based on technology available at that time
- ➡ Provide engine manufacturers with a known fuel quality for designing engines
- ➡ Addressed fuel related engine performance problems and excess emissions
- ➡ More stringent than CPUC specifications
- ➡ No national motor vehicle specification

Current Motor Vehicle CNG Specifications

Methane (min.)	88 mol%
Ethane (max.)	6 mol%
C3+higher (max.)	3 mol%
Inert Gases	1.5 - 4.5 mol%

Other specs. to safeguard quality

Current Natural Gas Supply

➡ **88% of California supply meets CNG MV specifications**

➡ **Importation of LNG**

- **One LNG terminal could supply 14% of CA supply**
- **Potential to change the energy content of natural gas which could:**
 - **Increase emissions**
 - **Cause durability and performance problems for existing stationary and mobile source equipment**

Fuel Quality and Emissions

- 👉 **Test programs confirm that an increase in energy content will increase NOx emissions**
 - Stationary sources
 - Mobile sources
- 👉 **Current information indicates that NOx emission increases may be significant**
- 👉 **Additional tests need to be conducted to fully quantify the performance and emissions impacts**

Joint Workshop on Gas Quality held on February 16th and 17th, 2005

- ☞ Hosted by CPUC, CEC, ARB, and DOGGR**
- ☞ Explored potential issues involving natural gas quality, interchangeability, and related specifications affecting its use in California**
- ☞ Helped provide a foundation for agencies to develop recommendations to resolve issues**

Next Steps

- ➡ **Continue to work with other state agencies & stakeholders**
- ➡ **Hold workshop on August 3rd, 2005 to discuss CNG strawman proposal**
- ➡ **As appropriate, bring proposed revisions to the CNG specifications to the Board for consideration including emissions and cost impacts**

Liquefied Petroleum Gas

Liquefied Petroleum Gas Motor Vehicle Fuel Regulation

- ☞ Title 13, CCR, section 2292.6 adopted in 1992**
- ☞ Compositional specifications**
- ☞ Based on technology available at that time**
- ☞ Provide engine manufacturers with a known fuel quality for designing engines**
- ☞ Addressed fuel related engine performance problems and excess emissions**
- ☞ No national motor vehicle specification**

Adjustments to LPG Specification to ensure adequate supply

☞ 1997 amendments

- extend 10% propene specification to January 1999**
- delay 5% propene specification by 2 years**

☞ 1998 amendments

- elimination of 5% propene specification**

Current Motor Vehicle LPG Specifications

Propane	85.0 vol% (min.)
Propene	10.0 vol% (max.)
Butenes + higher	5.0 vol% (max.)
Volatility residue	
evap. temp. 95%	-37° F (max.) or
C4+ higher	0.5 vol% (max.)
Residual Matter	
Residue on evap. of 100 ml	0.05 ml. (max.) or
Oil Stain	Not present
Sulfur (max.)	120 ppmw

Other specs. to safeguard quality

Large Spark Ignition

- ➡ **Proposed exhaust emission standards will require a consistent and clean fuel to facilitate the use of advance fuel injection systems**

Issues with LPG quality

- ➡ **Inconsistent fuel quality**
- ➡ **Unacceptable residual heavy hydrocarbons**

Proposed LPG Fuel Survey

- ➡ **Sample throughout California**
- ➡ **Identify potential sources of contamination**
 - **Production**
 - **Distribution system**

Possible Actions

- ➡ **Revise LPG specifications for residual hydrocarbon**
- ➡ **Implement measures to minimize contamination**

Biodiesel

Biodiesel Greenhouse Gas Benefits

👉 Based on lifecycle analysis

- 1 gallon of diesel produces 28 lbs of CO₂
- 1 gallon of B100 produces 6 lbs of CO₂ emissions

👉 Reduces greenhouse gas emissions

- Biodiesel could displace about 1% of diesel fuel and reduce CO₂ emissions by 300,000 tons

Other Biodiesel Benefits

- ➡ **Reduces PM and toxic emissions**
- ➡ **Biodiesel can be used with no engine modification**

Can Biodiesel be Used in CA?

Yes if:

- ☞ Meets ARB diesel regulations for sulfur and aromatics**
- ☞ Meets Division of Measurement Standards specifications**
 - Limits retail sales to B20 or less**
 - B100 can be used in non retail or with a fuel variance**

Biodiesel Emission Impacts

	B20	B100
HC	-21%	-67%
PM	-10%	-48%
CO	-11%	-48%
NOx	+2%	+10%

A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions, **Draft Technical Report, EPA420-P-02-001, October 2002**

Compatibility with Verified Diesel PM Controls

- ➡ **Compatibility demonstration of B20 underway**
 - **Would allow verified devices to use B20**

ARB Biodiesel Workgroup

- ➡ **Established in 2004 to assist the ARB in determining the need to develop biodiesel specifications**
- ➡ **First meeting held in March 2004**
- ➡ **Second meeting held in June 2005**

Coordination with the California Energy Commission

- ➡ **Biodiesel considered a renewable fuel**
- ➡ **Supports energy diversity**
- ➡ **Determine biodiesel market feasibility**
- ➡ **Assess air quality impacts**

Next Steps

- ➡ **Continue to work with ASTM, CEC, and industry to resolve remaining issues**